Antimicrobial resistance in *K. pneumoniae* in hospitalised and outpatients in Germany, 2009

Noll I., Schweickert B., Feig M., Krause G., Eckmanns T. ■ Robert Koch Institute, Berlin

### Objectives
A major finding of the European Antimicrobial Resistance Surveillance Network (EARS-Net) Report 2009 is the high prevalence of resistance in invasive *K. pneumoniae* isolates from hospitalised patients to third-generation cephalosporins (3GC), fluoroquinolones (FQ) and aminoglycosides (AG) and the high level of combined resistance to these classes in most European countries. Data from the German Antimicrobial Resistance Surveillance (ARS) System are used to extend the study of resistance to isolates from urine and respiratory samples as well as to outpatients.

### Results
The sample is composed of 5,548 non-duplicate *K. pneumoniae* isolates from inpatients (blood: 299; respiratory samples: 1,118; urine: 4,131) and 2,666 isolates from outpatients (respiratory samples: 173; urine: 2,493). Results are displayed in table 1 and visualised in figure 1 below. Proportions of resistance are highest against fluoroquinolones in all subsets ranging from 21.1% in blood cultures from inpatients to 4.6% in respiratory samples from outpatients followed by third-generation cephalosporins (16.4% to 3.5%) and aminoglycosides (13.4% to 2.3%).

Regarding resistance against the three antibiotic classes simultaneously reveals that triple resistance is the most frequent pattern in all inpatient subsets reaching 10.0% in blood cultures, 9.3% in respiratory samples and 6.8% in urine. In outpatient samples, single resistance against fluoroquinolones is the most frequent pattern followed by triple resistance in second place accounting for 3.0% in urine samples and 1.2% in respiratory samples.

### Materials & Methods
The dataset is taken from the German Antimicrobial Resistance Surveillance (ARS) System. In contrast to the EARS-net surveillance limited to invasive isolates from inpatients, ARS collects resistance data for all species originating from all kinds of specimens taken in hospitals as well as in ambulatory care.

Analysis is based on non-duplicate isolates of *K. pneumoniae* collected in 2009 by eight laboratories covering 160 hospitals and 865 practices. Species identification and antimicrobial susceptibility testing is performed by VITEK 2, results are evaluated according to CLSI guidelines. Isolates are classified as resistant to an antibiotic class if they show resistance to one of its agents:

- third-generation cephalosporins: ceftazidime or cefotaxime or ceftriaxone
- fluoroquinolones: ciprofloxacin or levofloxacin
- aminoglycosides: gentamicin or tobramycin or amikacin.

The distinct class resistances are combined to resistance patterns.

### References
ARS-Website: https://ars.rki.de

### Figures
- Figure 1: Resistance patterns in *Klebsiella pneumoniae*

### Tables
**Table 1: Resistance to antibiotic class**

<table>
<thead>
<tr>
<th></th>
<th>Hospitalised patients</th>
<th>Outpatients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blood</td>
<td>Respiratory</td>
</tr>
<tr>
<td></td>
<td>n=299</td>
<td>n=1,118</td>
</tr>
<tr>
<td>Fluoroquinolones (FQ)</td>
<td>21.1</td>
<td>15.0</td>
</tr>
<tr>
<td>Third-gen. cephalosporines (3GC)</td>
<td>16.4</td>
<td>14.5</td>
</tr>
<tr>
<td>Aminoglycosides (AG)</td>
<td>13.4</td>
<td>10.9</td>
</tr>
</tbody>
</table>

**Table 2: Resistance patterns**

- **Fully susceptible**
  - Blood: 76.3
  - Respiratory: 82.4
  - Urine: 80.5
  - Hospitalised patients: 93.6
  - Outpatients: 88.0

- **Single resistance**
  - FQ: 6.7
  - AG: 0.0
  - FQ + 3GC: 3.7
  - FQ + AG: 2.3
  - AG + 3GC: 1.0
  - Blood: 7.0
  - Respiratory: 4.2
  - Urine: 5.6
  - Hospitalised patients: 1.7
  - Outpatients: 3.2

- **Double resistance**
  - Blood: 7.0
  - Respiratory: 4.2
  - Urine: 5.6
  - Hospitalised patients: 1.7
  - Outpatients: 3.2

- **Triple resistance**
  - Blood: 10.0
  - Respiratory: 9.3
  - Urine: 6.8
  - Hospitalised patients: 1.2
  - Outpatients: 3.0

### Conclusion
Surveillance limited to invasive isolates from hospitalised patients like EARS-Net captures the sector with highest levels of antimicrobial resistance in *K. pneumoniae*; the extended approach of ARS reveals an emerging problem in outpatient care that physicians should be aware of, even if resistance proportions might be overestimated as samples are more likely to be taken from pre-treated patients.

### Acknowledgements
We like to thank for their contribution to this presentation:
- Gemeinschaftspraxis für Laboratoriumsmedizin, Plön ■ Institut für Infektionsmedizin, Universitätsklinikum Schleswig-Holstein, Kiel ■ Institut für Hygiene und Medizinische Mikrobiologie, Universitätsklinikum Heidelberg ■ Labor 28, Berlin ■ Labor Dr. Limbach & Kollegen, Heidelberg ■ MVZ Dortmund - Dr. Eberhard & Partner, Dortmund ■ MVZ Dr. Lörer - Dr. Treder und Kollegen, Münster ■ MVZ Dr. Stein und Kollegen, Mönchengladbach

Contact: Ines Noll, Robert Koch Institute, Department for Infectious Disease Epidemiology, DGZ-Ring 1, D-13086 Berlin, e-mail: Noll@rki.de